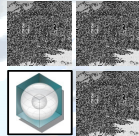


RECOMMENDATIONS FOR 15% ABOVE-CODE ENERGY EFFICIENCY MEASURES FOR SINGLE FAMILY RESIDENCES

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OUTLINE

Introduction
Base-Case Building
Energy Efficiency Measures
Results
Conclusion

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INTRODUCTION

THE 79TH LEGISLATURE TO ENHANCE EFFECTIVENESS OF SENATE BILL 5

Requires the Laboratory

To develop 3 methods for achieving at least 15% potential energy savings in residential, commercial and industrial construction.

The Process

Worked on residential and commercial measures
Held stakeholders meetings
Refined measures

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BASE-CASE

As per IECC 2001 for Residential Buildings

Two system types:
Electric cooling Natural gas heating (Electric / Gas)
Electric cooling Electric heating (All - Electric)

Building Envelope

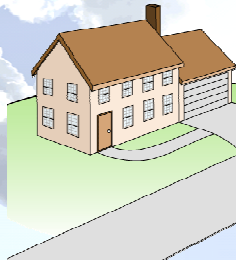
- Detached single story (2325 ft²) in Houston, TX
- Vented, unconditioned attic
- Light weight wood frame construction
- Ceiling R-value: R-30
- Wall R-value: R-11.76
- Un-insulated slab-on-grade

Fenestration

- 18% window to floor area ratio
- U-value: 0.47 Btu/hr °F ft²
- SHGC: 0.40

Air Infiltration

- Conditioned space 0.47 ACH
- Attic 15 ACH



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BASE-CASE

As per IECC 2001 for Residential Buildings

Two system types:
Electric cooling Natural gas heating (Electric / Gas)
Electric cooling Electric heating (All - Electric)

HVAC System Characteristics

For cooling

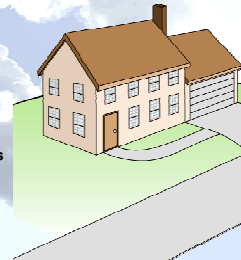
- Air-conditioner with SEER 13

For heating

- Electric / gas building –
Gas fired forced air furnace AFUE - 0.78
- All-Electric building –
Heat Pump HSPF - 7.7

Air Distribution System Characteristics

- Ducts in attic
- 10% duct leakage
- Supply duct R-value – R-8
- Return duct R-value – R-4



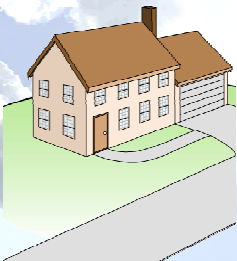
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BASE-CASE
As per IECC 2001 for Residential Buildings

Two system types:
Electric cooling Natural gas heating (Electric / Gas)
Electric cooling Electric heating (All - Electric)

DHW System Characteristics

- Daily hot water use 70 gallons/day
- For Electric / Gas
 - 40 gallon storage
 - Energy Factor – 0.54
 - Pilot light
- For All-Electric
 - 50 gallon storage
 - Energy Factor – 0.86



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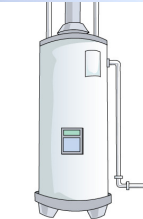
ENERGY EFFICIENCY MEASURES

12 INDIVIDUAL MEASURES

DHW System Measures

- 1. Tankless Domestic Water Heater** (Electric/Gas & All-Electric)
 - For Electric / Gas
 - No Pilot light
 - Energy Factor raised from 0.54 to 0.85
 - For All-Electric
 - Energy Factor raised from 0.86 to 0.95
- 2. Solar Domestic Water Heater** (Electric/Gas & All-Electric)

Solar DHW Characteristics	
Number of collector panels	2
Collector panel area	32 sq. ft.
Collector slope	30 deg.
Collector azimuth (South=0)	0 deg.
Number of glazing	1
Collector flow rate/area	11 lb/hr-sq. ft.
Water set temperature	120 deg. F
Daily hot water usage	70 gal.
- 3. Removal of Standing Pilot Light from Gas DHW** (Electric/Gas)




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ENERGY EFFICIENCY MEASURES

12 INDIVIDUAL MEASURES

Air Distribution System Measures

- 4. Ducts in Conditioned Space** (Electric/Gas & All-Electric)
 - Moving ductwork and HVAC system within the thermal envelope
- 5. Improved Duct Sealing** (Electric/Gas & All-Electric)
 - Changing from 10% to 5%



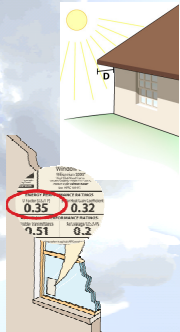
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ENERGY EFFICIENCY MEASURES

12 INDIVIDUAL MEASURES

Envelope & Fenestration Measures

- 6. Increased Air-Tightness**
 - Changing from 0.47 to 0.35
- 7. Addition of Window Shading**
 - Roof overhangs of 4 ft
- 8. Window Shading and Re-distribution**
 - From 18% WFAIR distributed 25% WWAR on each orientation to windows distributed 45% on the south, 25% on the north, 15% each on east and west orientations
 - 4 ft. roof overhang was also included on all four sides
- 9. Improved Window Performance**
 - 0.42 Btu/h-sq. ft.-°F
 - SHGC 0.33.



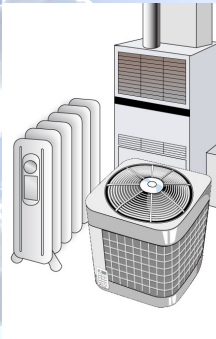
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ENERGY EFFICIENCY MEASURES

12 INDIVIDUAL MEASURES

HVAC System Measures

- 10. Improved Air Conditioning Efficiency**
 - From SEER 13 to SEER 15
- 11. Improved Furnace Efficiency**
 - From 0.78 AFUE to 0.93 AFUE
- 12. Improved Efficiency of the Heat Pump**
 - From 7.7 HSPF to 8.5 HSPF



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ENERGY EFFICIENCY MEASURES

COMBINED SET OF MEASURES

Combination 1

- Tankless Water Heater (Without Standing Pilot Light)
- Relocate HVAC Unit Including Supply and Return Ducts in Conditioned Space

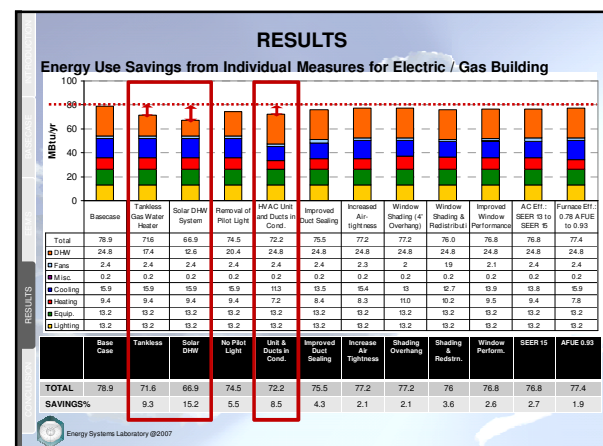
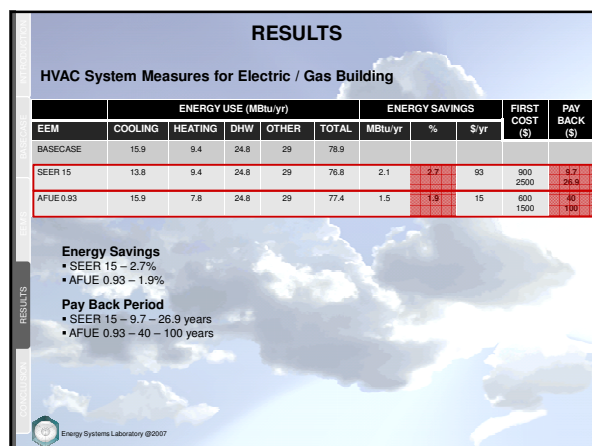
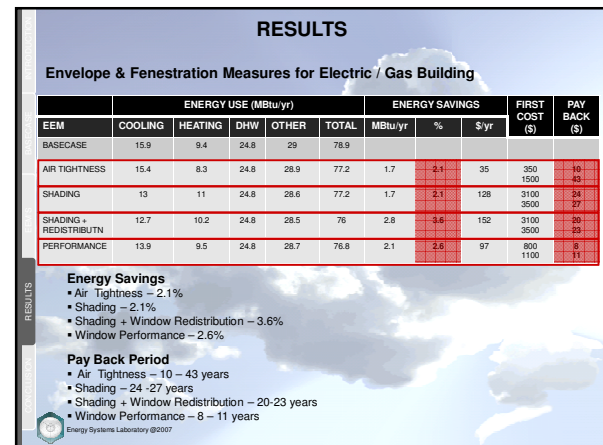
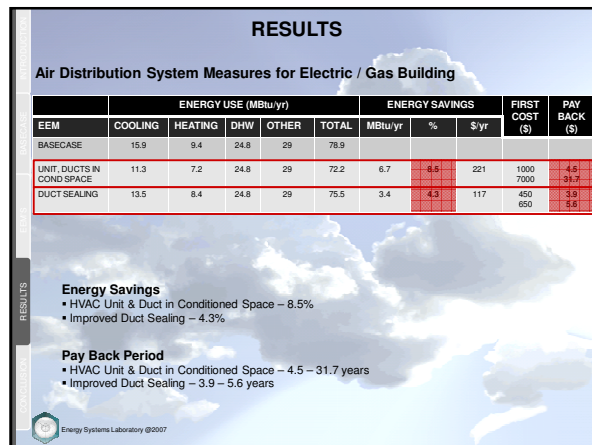
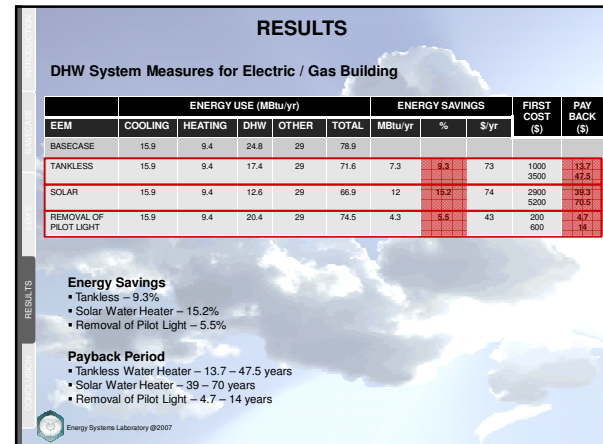
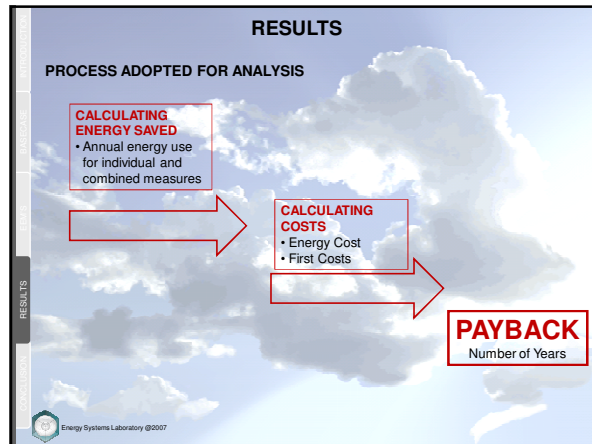
Combination 2

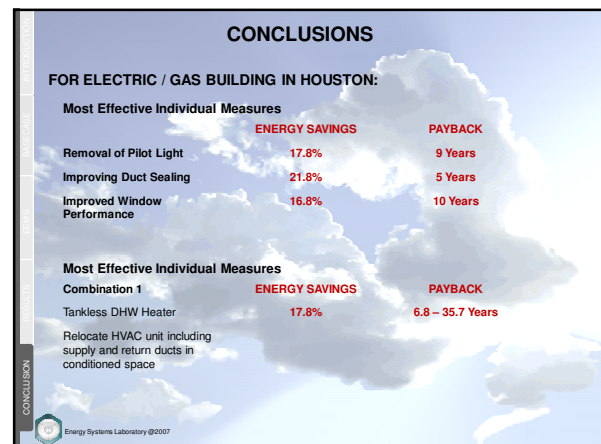
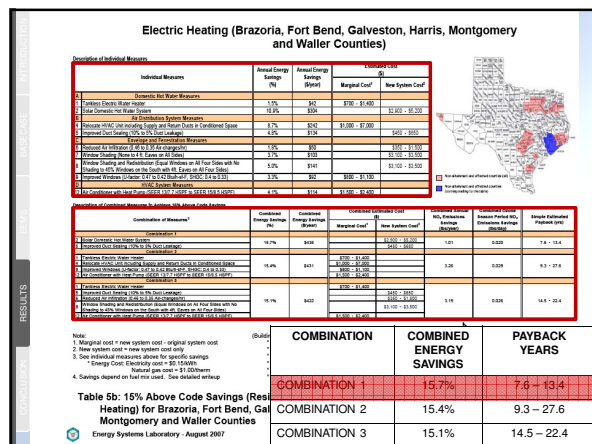
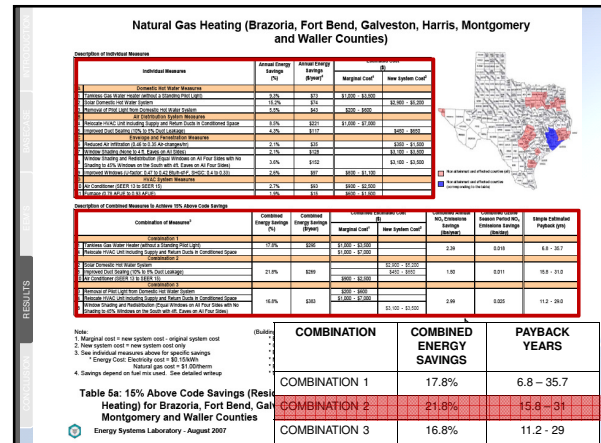
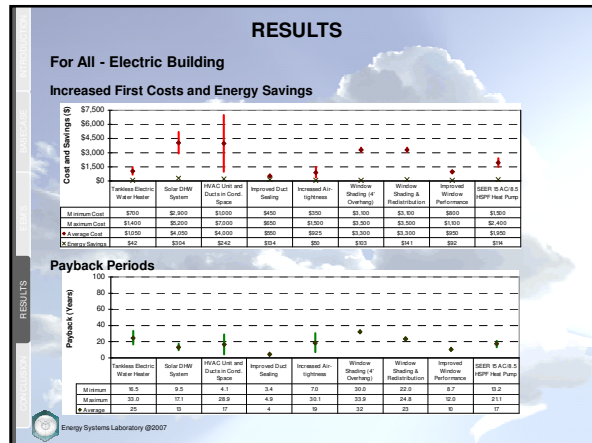
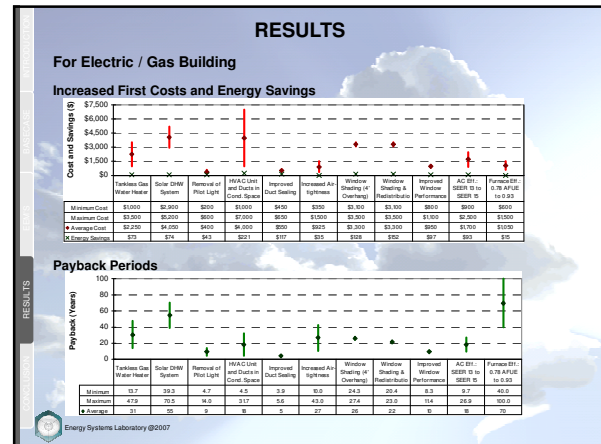
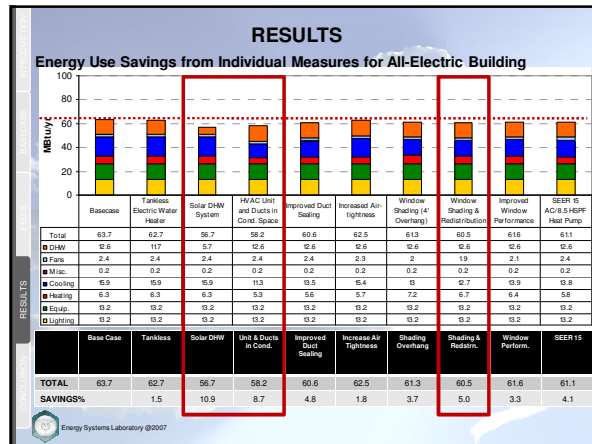
- Solar Domestic Hot Water System
- Improved Duct Sealing (5% Duct Leakage)
- Improved Air Conditioner (SEER 15)

Combination 3

- Removal of Pilot Light from DHW System
- Relocate HVAC Unit including Supply and Return Air-Ducts in Conditioned Space
- Window Shading and Redistribution

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CONCLUSIONS

FOR ALL - ELECTRIC BUILDING IN HOUSTON:


Most Effective Individual Measures

	ENERGY SAVINGS	PAYBACK
Improved Duct Sealing	17.8%	4 Years
Improved Window Performance	3.3%	10 Years
Solar Hot Water System	10.9%	13 Years

Most Effective Individual Measures Combination 1

	ENERGY SAVINGS	PAYBACK
Solar Hot Water System	15.7%	7.6 – 13.5 Years
Improved Duct Sealing		


CONCLUSION

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